DRAFT
Delisting Decision
For

McKiernan Creek (Wilson Lake)

Assessment Unit ID # AL06030005-0801-201

Organic Enrichment (CBOD, NBOD) Nutrients

Alabama Department of Environmental Management
Water Quality Branch
Water Division
January 2018

Figure 1: McKiernan Creek Location Map in the Tennessee River Basin

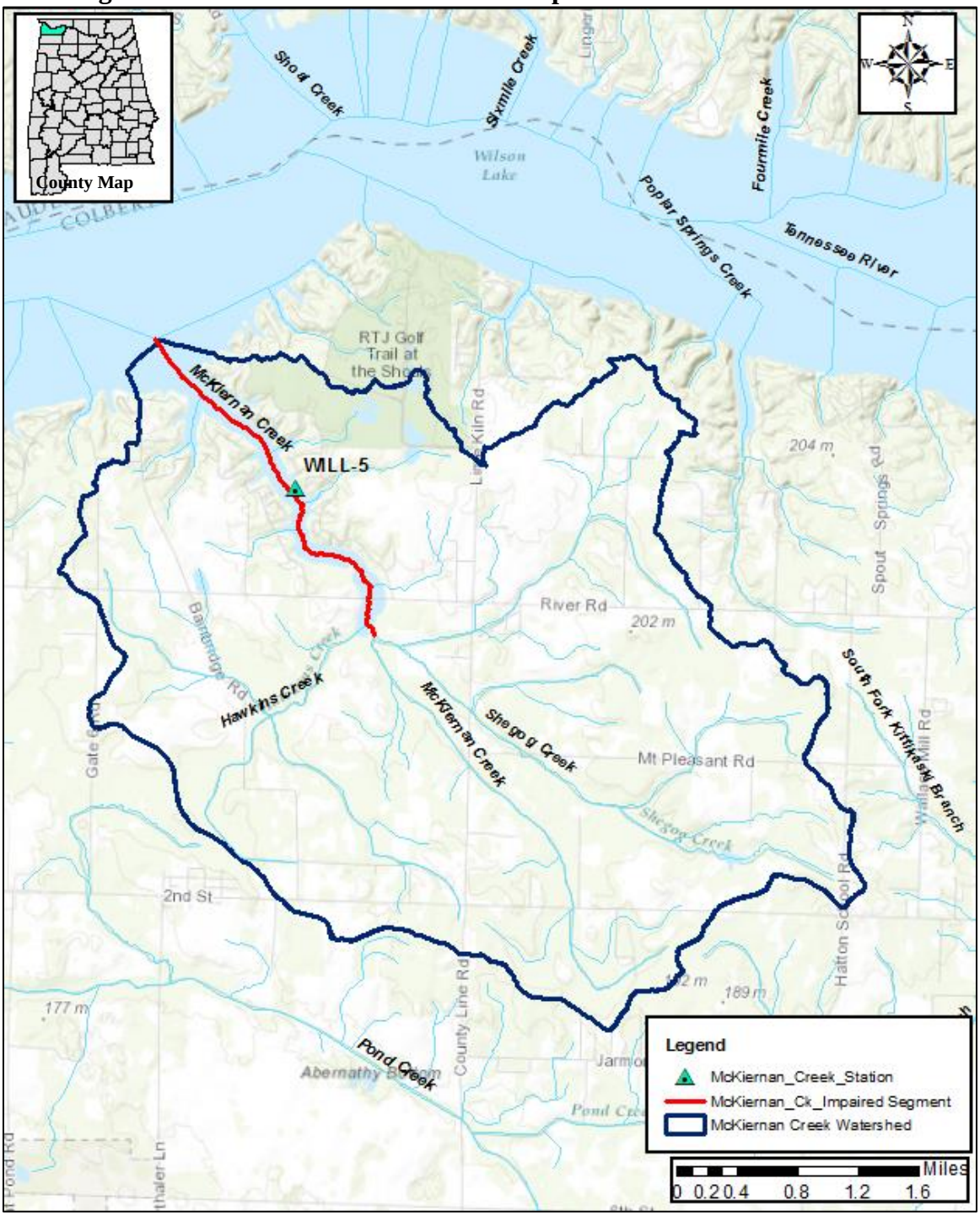


Table of Contents

Table of Figures

1.0 Executive Summary

McKiernan Creek, located in Colbert County, is part of the Tennessee River Basin. McKiernan Creek flows into Wilson Lake of the Tennessee River. It has a total drainage area of approximately 15 square miles. The McKiernan Creek watershed consists of agriculture and forested land. McKiernan Creek has the following use classifications: Public Water Supply (PWS), Swimming (S), and Fish and Wildlife (F&W). The impaired segment addressed in this delisting decision is listed in Table 1.

McKiernan Creek was first placed on the State of Alabama's §303(d) List in 1998 by EPA for ammonia, nutrients, siltation, and OE/DO (organic enrichment/dissolved oxygen). The source of impairment was later listed as agriculture. A delisting report addressing the ammonia impairment for McKiernan Creek was approved in 2012, and consequently the ammonia pollutant for McKiernan Creek was removed from Alabama's 2012 §303(d) list. Subsequent data from ADEM's surface water quality monitoring program have shown no impairment with respect to nutrients and organic enrichment.

The most recent water quality data available for McKiernan Creek was collected in 2013 and 2015 at sampling station WILL-5. The median Total Phosphorus (TP) and Total Nitrogen (TN) values from the McKiernan Creek data are below the applicable ecoregional reference values. Chlorophyll *a* concentrations were below ADEM's chlorophyll a criteria for Wilson Lake. In addition, between September 23, 2015, and September 28, 2015, diurnal Dissolved Oxygen (DO) data was collected at McKiernan Creek sampling station WILL-5. DO concentrations and pH levels at the station remained within acceptable levels.

Also, the concentrations of oxygen-demanding pollutants ($CBOD_5$, NH_3-N, and TKN) in McKiernan Creek were low, in the range of background conditions for such pollutants. The grab samples collected for the §303(d) program during 2013 and 2015 were above the minimum DO criteria. The data indicates that McKiernan Creek, from the end of the embayment to the Tennessee River, now fully supports its use classification with respect to nutrients and organic enrichment.

This report addresses the results of the delisting analysis for McKiernan Creek. Based on the assessment of all available water quality data, ADEM has determined that McKiernan Creek is not impaired due to nutrients and organic enrichment, and water quality standards are being attained. Therefore, ADEM will not develop a Total Maximum Daily Load (TMDL) in light of "more recent or accurate data," which is just cause for delisting a waterbody according to Title 40 of the Code of Federal Regulations (CFR), Part 130.7(b)(6)(iv).

Table 1: McKiernan Creek Segment from the 2016 §303(d) List

ID	Use	Cause	Year Listed	Size	Downstream / Upstream Locations
AL06030005-0801-201	Public Water Supply Swimming Fish & Wildlife	Nutrients Organic Enrichment (CBOD, NBOD) Siltation (habitat alteration)	1998	212.45 acres	Tennessee River / end of embayment

2.0 Basis for §303(d) Listing

Section 303(d) of the Clean Water Act (CWA), as amended by the Water Quality Act of 1987 and EPA's Water Quality Planning and Management Regulations [Title 40 of the Code of Federal Regulations (CFR), Part 130], requires states to identify waterbodies which are not meeting water quality standards applicable to their designated use classifications. The identified waters are prioritized based on severity of pollution with respect to designated use classifications. TMDLs for all pollutants causing violation of applicable water quality standards are established for each waterbody identified as impaired. Such loads are established at levels necessary to implement the applicable water quality standards with seasonal variations and margins of safety. The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a waterbody, based on the relationship between pollution sources and instream water quality conditions, so that states can establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991).

In 1998, McKiernan Creek was placed on the State of Alabama's §303(d) List for Ammonia, Nutrients, Siltation and Organic Enrichment/Dissolved Oxygen (OE/DO). The rationale for McKiernan Creek's listing on the 1998 §303(d) list is unclear. The first record of McKiernan Creek being impaired is noted in EPA's additions to the 1998 §303(d) list. McKiernan Creek was listed as non-supportive of its use classification caused by ammonia, nutrients, siltation and OE/DO. However, no physical, chemical, or biological records could be found to substantiate the support status of McKiernan Creek. A records search through old Nonpoint Source complaint files yielded no information on McKiernan Creek. Since no data could be located, it is assumed that the listing of McKiernan Creek was based on observations rather than actual water quality monitoring data.

3.0 Source Assessment

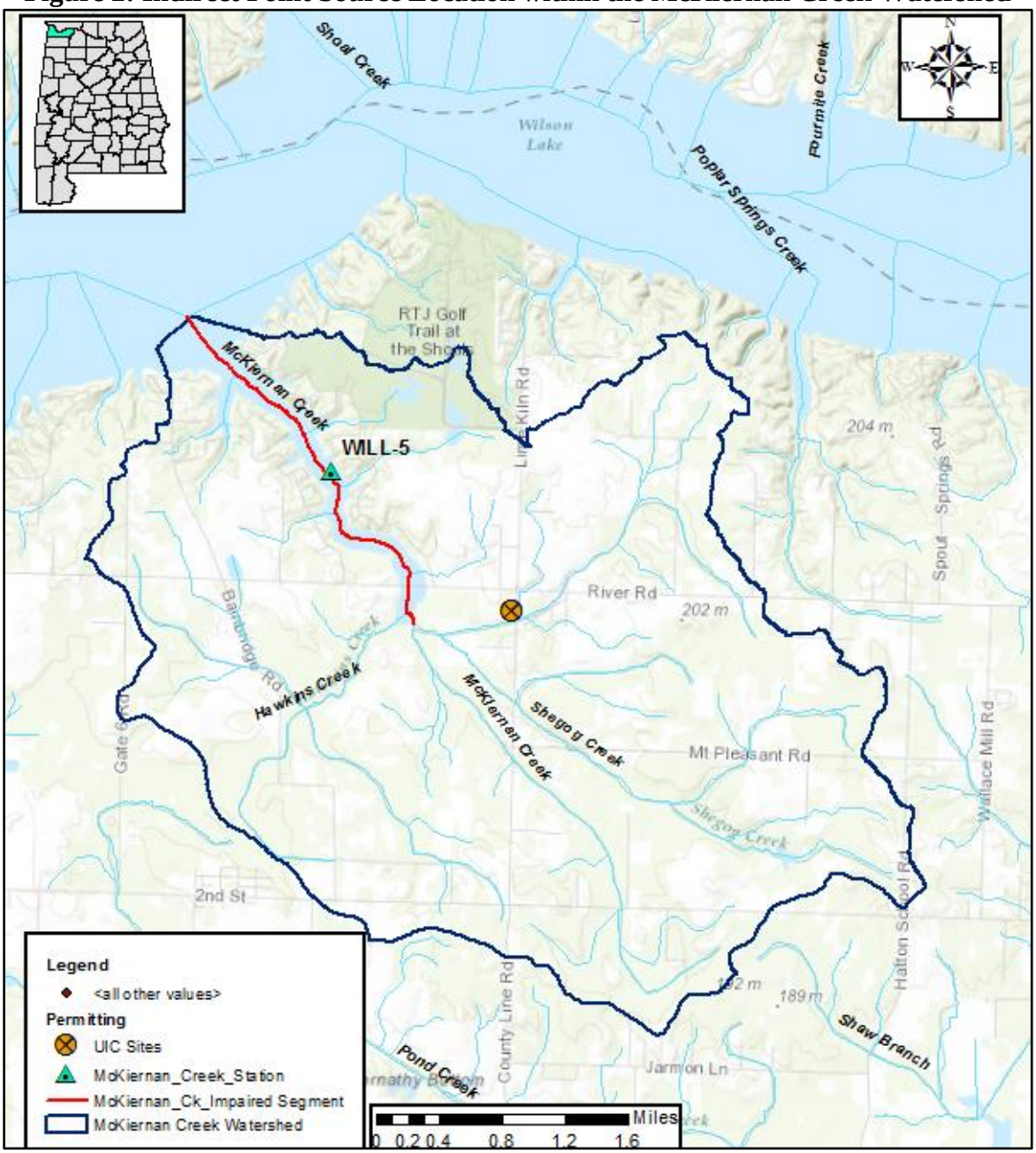
3.1 Indirect Point Sources

National Pollutant Discharge Elimination System (NPDES) permitted facilities are an important consideration in evaluating a watershed; however, the listed portion of McKiernan Creek watershed has no active NPDES permits. King Car Wash, an indirect point source, operates an underground injection control system in the McKiernan Creek watershed. Table 2 lists relevant data for the facility. Figure 2 is a map of the respective location in the watershed.

Table 2: Indirect Point Sources in the McKiernan Creek Watershed

Facility	Permit #	Permit type	Permit Status
King Car Wash	ALSI9917521	UIC Sites	In Effect

Figure 2: Indirect Point Source Location within the McKiernan Creek Watershed



3.2 Nonpoint Sources

Nonpoint impacts in the McKiernan Creek watershed are considered to come from its land uses. Land use percentages were determined from the 2011 National Land Cover Dataset (NLCD). Table 3 lists the land use areas and percentages in the watershed as shown in Figure 3. Figure 4 is a map of the watershed's land use. As can be seen from an inspection of the table and map, the predominant land uses in the watershed are agriculture (63.19%) and forested (19.13%). The watershed is relatively small measuring at a total area of 15.18 square miles.

Table 3: Land Use Data

Land Use Description	Square Miles	Percent (%)
Open Water	0.480233865	3.16%
Developed, Open Space	0.950042971	6.26%
Developed, Low Intensity	0.058031154	0.38%
Developed, Medium Intensity	0.037181638	0.24%
Developed, High Intensity	0.002084952	0.01%
Barren Land	0.00173746	0.01%
Deciduous Forest	1.470585901	9.69%
Evergreen Forest	0.343669531	2.26%
Mixed Forest	0.392665895	2.59%
Shrub/Scrub	0.945525576	6.23%
Herbaceous	0.208842658	1.38%
Hay/Pasture	6.530763571	43.03%
Cultivated Crops	3.061404015	20.17%
Woody Wetlands	0.691856458	4.56%
Emergent Herbaceous Wetlands	0.004169903	0.03%
Total Land Use	**15.17879555**	**100.00%**
Cumulative Land Use	**Square Miles**	**Percent (%)**
Developed	1.047340715	6.90%
Forested	2.902947689	19.13%
Agriculture	9.592167586	63.19%
Grassland/Shrubs	1.154368234	7.61%
Other	0.481971325	3.18%
Total Land Use	**15.17879555**	**100.00%**

Figure 3: Pie Chart of Land Use Distribution in McKiernan Creek Watershed

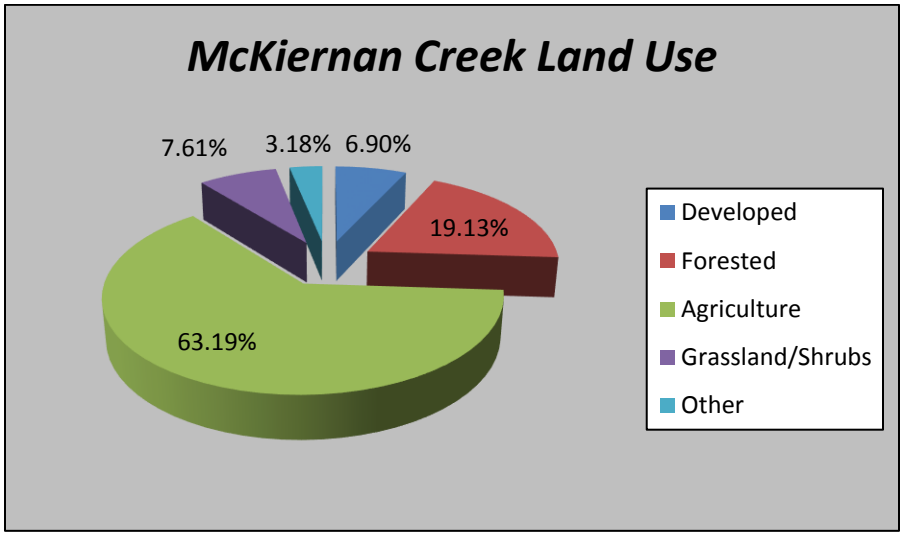
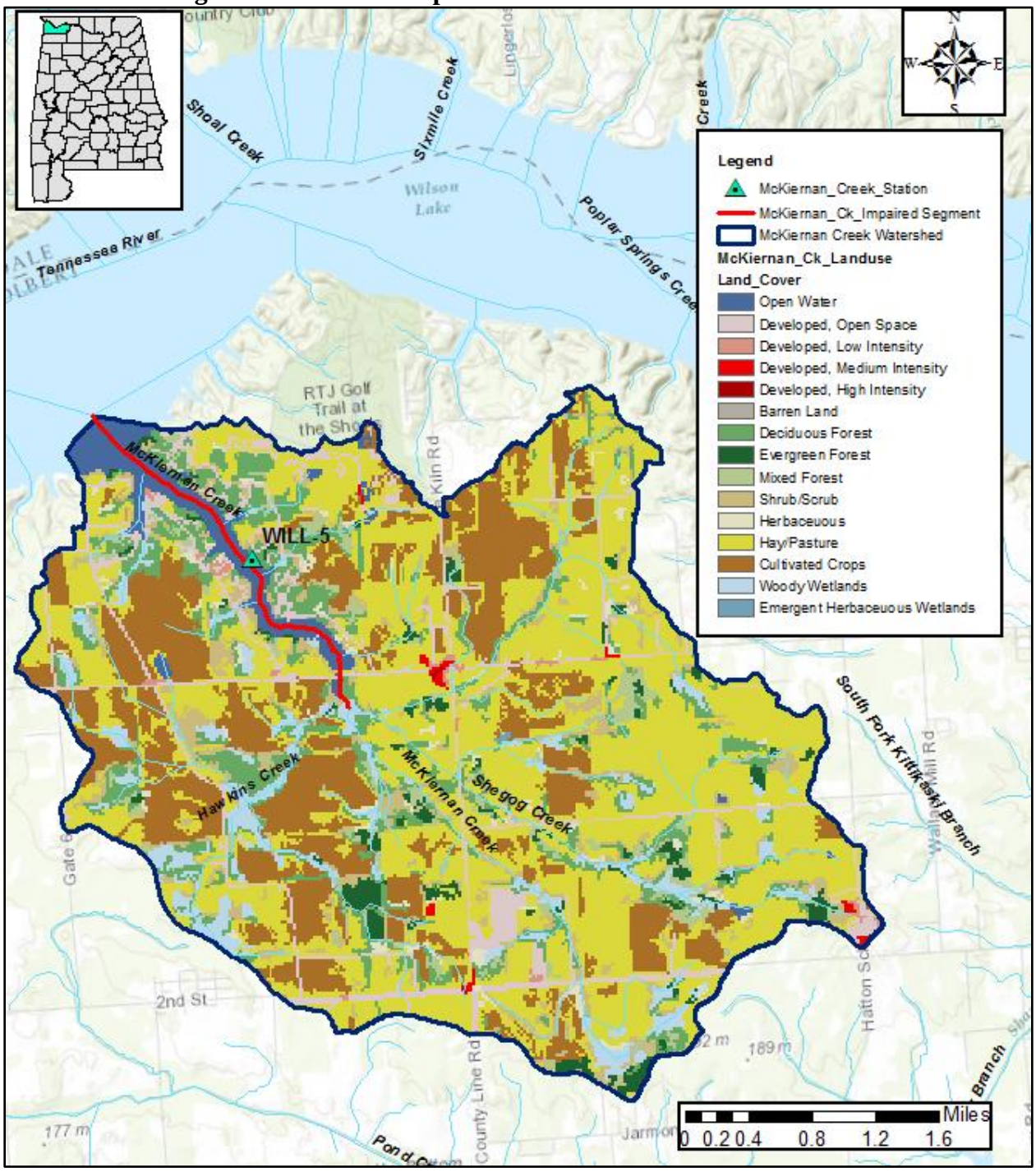


Figure 4: Land Use Map of the McKiernan Creek Watershed



4.0 Technical Basis for Delisting Decision

4.1 Water Quality Target Identification

Historically, in the absence of established numeric criteria, ADEM and/or EPA would use available data and information coupled with best professional judgment to determine overall use

support for a given waterbody. Narrative criteria continue to serve as a regulatory basis for determining use support and making listing/delisting decisions of waters in regards to Alabama's §303(d) List. ADEM's Narrative Criteria, as shown in ADEM's Administrative Code, Rule 335-6-10-.06, are as follows:

335-6-10-.06 Minimum Conditions Applicable to All State Waters. *The following minimum conditions are applicable to all State waters, at all places and at all times, regardless of their uses:*

(a) State waters shall be free from substances attributable to sewage, industrial wastes or other wastes that settle to form bottom deposits which are unsightly, putrescent or interfere directly or indirectly with any classified water use.

(b) State waters shall be free from floating debris, oil, scum, and other floating materials attributable to sewage, industrial wastes or other wastes in amounts sufficient to be unsightly or which interfere directly or indirectly with any classified water use.

(c) State waters shall be free from substances attributable to sewage, industrial wastes or other wastes in concentrations or combinations, which are toxic or harmful to human, animal or aquatic life to the extent commensurate with the designated usage of such waters.

For purposes of evaluating attainment of the above narrative criteria, ADEM will use both EPA's national recommended water quality criteria and ADEM's ecoregional reference guidelines. EPA's recommended criteria for approximately 150 pollutants are published under section 304(a) of the Clean Water Act. In 2010, ADEM published ecoregional reference guidelines for a number of parameters and pollutants. A listing of the guidelines can be found in Appendix 7.3. Reference streams, also referred to as "reference reaches" or "ecoregional reference sites," are defined as relatively homogeneous areas of similar climate, land form, soil, natural vegetation, hydrology, and other ecologically relevant variables (USEPA, 2000b) which have remained comparatively undisturbed or minimally impacted by human activity over an extended period of time in relation to other waters of the State. While not necessarily pristine or completely undisturbed by humans, reference streams do represent desirable chemical, physical and biological conditions for a given ecoregion that can be used for evaluation purposes.

The reference streams selected for a particular analysis depends primarily on the available number of reference streams and associated data within a particular ecoregion. Therefore, the total number of reference sites selected and the aerial scale (i.e., Ecoregion Level III, Level IV) used to represent a reference condition will often vary on a case-by-case basis. ADEM elected to use the 90th percentile of the data distributions from the selected reference sites. In Figure 6 (Appendix 7.3), the ecoreference location map, the impaired segment is shown to be in Level IV ecoregion 71g. Since there are no published Level IV values for ecoregion 71g, the Level III values from ecoregion 71 were employed.

Nutrient Criteria: ADEM is continuing its efforts to develop comprehensive numeric nutrient criteria for all surface waters throughout Alabama, including rivers/streams, lakes/reservoirs, wetlands, and coastal/estuarine waters. However, until numeric nutrient criteria or some form of quantitative interpretations of ADEM's narrative criteria are developed, the Department will

continue to use all available data and information coupled with best professional judgment to make informed decisions regarding overall use support and when establishing numeric targets for TMDLs.

Alabama does not currently have numeric nutrient criteria for rivers and streams with respect to assessment and listing decisions. Typically, numeric targets are established using ADEM's 2010 Ecoregional Reference Guidelines and enforced under the narrative criteria discussed above. The 90th percentile of the data distribution was considered an appropriate target, since it falls within an acceptable range of "least-impacted" conditions (i.e. upper quartile). For ecoregion 71, the 90th percentile value for TP was determined to be 0.0497 mg/L. The ecoregional reference value for TN is 1.57 mg/L. If the TP and TN concentrations of the subject impaired stream are relatively the same or below reference condition levels, then the stream is considered not to be impaired for nutrients. If TP and TN concentrations within the impaired stream are shown to be above reference conditions, then other water quality data and information are used in the evaluation. Additional data and information that can be used includes diurnal dissolved oxygen readings.

Chlorophyll *a* is another parameter to consider when evaluating nutrient impairment. Chlorophyll *a* is a response variable influenced by a wide variety of factors including nutrient input. ADEM does not currently have chlorophyll a criteria for McKiernan Creek; however, McKiernan Creek is a tributary to Wilson Lake, which does have an established chlorophyll *a* criterion. According to ADEM's Water Quality Criteria (Administrative Code 335-6-10), the chlorophyll *a* criterion for Wilson Lake is as follows:

Chlorophyll a (corrected, as described in Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998): the mean of the photic-zone composite chlorophyll a samples collected monthly April through September shall not exceed 18 µg/l, as measured at the deepest point, main river channel, dam forebay.

Organic Enrichment (CBOD, NBOD) Criteria: According to ADEM's Water Quality Criteria (Administrative Code 335-6-10), the minimum dissolved oxygen concentration for waters classified as Public Water Supply, Swimming, and Fish and Wildlife is 5 mg/l. In the application of the criteria, the dissolved oxygen shall be measured at a depth of 5 feet in waters 10 feet or greater in depth.

In order to determine if an organic enrichment impairment exists in McKiernan Creek, the Department will evaluate dissolved oxygen concentrations against the above criteria. The Department will also focus on some of the primary drivers affecting instream dissolved oxygen concentrations, including carbonaceous biochemical oxygen demand (CBOD) and nitrogenous biochemical oxygen demand (NBOD). The 90^{th} percentile of the data distributions from the selected ecoregional reference sites will again be used in establishing CBOD and NBOD evaluation concentrations that will serve as values for comparison to the recently collected ambient water quality data.

4.2 Data Availability and Analysis

It should be noted that even though McKiernan Creek was sampled prior to 2013, only the data that is approximately six years in age or less will be used in this analysis, which is consistent with Alabama's Water Quality Assessment and Listing Methodology (ADEM, 2016). The source of data that was utilized in the evaluation of McKiernan Creek is from ADEM's §303(d) sampling program. In addition, in 2015, 72-hour continuous data for dissolved oxygen was collected on McKiernan Creek at station WILL-5 during the month of September. WILL-5 is located on the impaired portion of McKiernan Creek approximately half a mile upstream of the lake confluence. A description of the station and corresponding coordinates are listed in Table 4.

Table 4: ADEM Sampling Stations on McKiernan Creek

Station Name	Agency Name	Latitude	Longitude	Description
WILL-5	ADEM	34.79682	-87.54929	Deepest point main creek channel McKiernan Creek embayment approximately 0.5 miles upstream of lake confluence

4.2.1 Nutrient Analysis

An analysis of the nutrient data was conducted by comparing median TP and TN concentrations from station WILL-5 to the 90th percentile values listed for ecoregion 71. The 90th percentile ecoreference concentrations for TP and TN are 0.0497 mg/L and 1.57 mg/L, respectively. The median TP and TN concentrations were below ecological reference stream levels. Chlorophyll *a* concentrations within the impaired stream were evaluated as well using ADEM's chlorophyll *a* criterion for Wilson Lake. The growing season mean of the photic-zone composite chlorophyll *a* samples collected monthly April through September did not exceed 18 µg/l. Tables 5 and 6 below provide TP, TN, and chlorophyll a data for station WILL-5, located on the impaired portion of McKiernan Creek.

Table 5: TP & TN Data

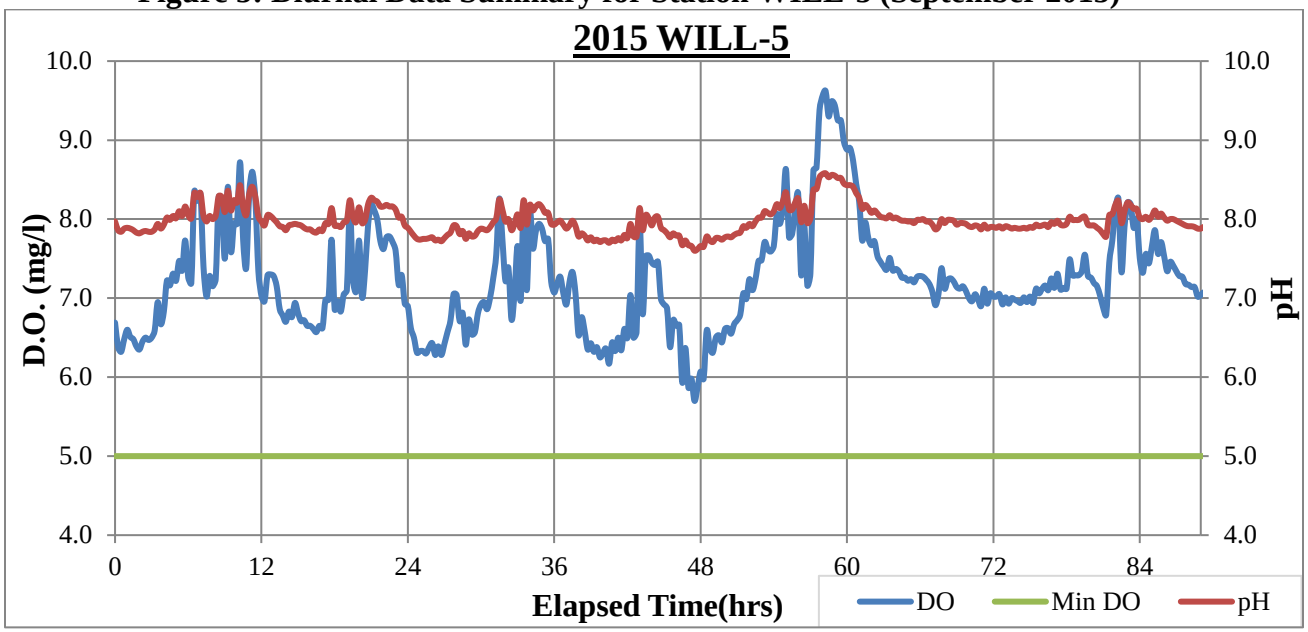
WILL-5 (2013, 2015)		
	TP (mg/L)	**TN (mg/L)**
Mean:	0.043	0.717
Median:	**0.040**	**0.697**
75th %tile:	0.052	0.889
90th %tile:	0.055	0.960
# Samples	14	14
Ecoreference 71	**0.0497**	**1.57**

Table 6: ADEM's Chlorophyll a Criteria for Wilson Lake

WILL-5		
	Chl a (ug/L)	**Chl a (ug/L)**
Year	**2013**	**2015**
Chlorophyll a GSM (ug/L):	**17**	**10**
Chlorophyll a Criteria	**18**	**18**
# Samples	6	6

In 2015, 72-hour continuous data for dissolved oxygen was collected at station WILL-5 during the month of September as part of an intensive water quality study. The pH at station WILL-5 remained in acceptable range. DO concentrations at station WILL-5 remained within normal levels during this sampling event, ranging between 5.7 mg/l and 9.6 mg/l, further providing evidence that McKiernan Creek is not impaired for nutrients. The diurnal data is shown in Figure 5.

Figure 5: Diurnal Data Summary for Station WILL-5 (September 2015)



Based on the instream TP and TN values, chlorophyll a values, pH readings, and dissolved oxygen concentrations, ADEM does not consider McKiernan Creek to be impaired as a result of nutrient over enrichment. The available data that was utilized to support this delisting decision can be found in Appendix 7.2.

4.2.2 Organic Enrichment (CBOD, NBOD) Analysis

The grab samples collected for the §303(d) program during 2013 and 2015 did not indicate low dissolved oxygen and were above the minimum criteria.

Table 7: §303(d) Sampling Program DO Data for McKiernan Creek (2013, 2015)

Station	# Grab Samples	Use Classification	Min. DO	# Violations
WILL-5	14	PWS/S/F&W	5 mg/L	0

Also, the 72-hour continuous data did not indicate low dissolved oxygen values during the water quality study.

Table 8: 72-hour Continuous DO Data McKiernan Creek (2013, 2015)

Station	# Samples	Use Classification	Min. DO	# Violations
WILL-5	500	PWS/S/F&W	5 mg/L	0

Water quality concentrations of oxygen-demanding pollutants ($CBOD_5$, NH_3-N, and TKN) in McKiernan Creek were low, in the range of background conditions for such pollutants. Typical background concentrations for unimpaired waterbodies are 1.33–2 mg/L $CBOD_5$, 0.11–0.22 mg/L NH_3-N, and 0.33–0.66 mg/L TKN. Examination of the water quality data demonstrates that these oxygen demanding pollutants were at or near background conditions in McKiernan Creek.

A comparison of monitoring results from WILL-5 with concentrations in the ecological reference sites demonstrates that CBOD levels in McKiernan Creek are below ecoreference conditions. Median ammonia levels at station WILL-5 are below ecological reference stream levels. The TKN median concentrations are somewhat elevated at station WILL-5. However, dissolved oxygen levels show that there is no impairment for organic enrichment.

Table 9: Statistical Summary of Oxygen-Demanding Pollutants

WILL-5 (2013, 2015)			
	NH_3 (mg/L)	**TKN (mg/L)**	**$CBOD_5$ (mg/L)**
Mean:	0.033	0.611	1.3
Median:	**0.009**	**0.643**	**1.0**
75th %tile:	0.021	0.753	1.0
90th %tile:	0.092	0.845	1.9
Ecoreference 71	**0.023**	**0.466**	**1.1**
# Samples	14	14	14

5.0 Conclusions

From examination of all available water quality data and information provided for McKiernan Creek, ADEM has determined that impairment due to nutrients and organic enrichment does not currently exist. Therefore, ADEM will not develop TMDLs for these pollutants in light of "more recent data," which is just cause for delisting a waterbody according to Title 40 of the Code of Federal Regulations (CFR), Part 130.7(b)(6)(iv). McKiernan Creek will be proposed for delisting as a part of the development process for Alabama's *2018 §303(d) List of Impaired Waters.*

6.0 Public Participation

As part of the public participation process, this Delisting Decision (DD) will be placed on public notice and made available for review and comment. A public notice will be prepared and published in the major daily newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject document will be made available on ADEM's Website: www.adem.state.al.us. The public can also request paper or electronic copies of the report by contacting Ms. Kimberly Minton at 334-271-7826 or kminton@adem.alabama.gov. The public will be given an opportunity to review the DD and submit comments to the Department in writing. At the end of the public review period, all written comments received during the public notice period will become part of the administrative record. ADEM will consider all comments received by the public prior to finalization of this DD and subsequent submission to EPA Region 4 for final review and approval.

7.0 Appendices

7.1 References

1. Alabama Department of Environmental Management, 1998-2016 Section 303(d) List

2. Alabama's §303(d) Monitoring Program. 2013 & 2015. ADEM.

3. ADEM Administrative Code, 2017. Water Quality Program, Chapter 335-6-10, Water Quality Criteria, and Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

4. United States Environmental Protection Agency. 1991. *Guidance for Water Quality-Based Decisions: The TMDL Process*, Office of Water, EPA 440/4-91-001.

5. Alabama Department of Environmental Management, Water Quality Assessment and Listing Methodology (ADEM 2016).

6. USEPA 304(a) National Recommended Water Quality Criteria (EPA OST, 2009).

7. Alabama Department of Environmental Management. *Alabama's 2010 Ecoregional Reference Guidelines*. 2010. ADEM

7.2 Water Quality Data

Table 10: Water Quality Data (DO, pH, T H_20, Btm Depth) 2013, 2015

Station ID	Visit Date	DO (mg/L)	pH_SU	T H_2O C	Btm Depth (m)
WILL-5	4/17/2013	11.9	8.6	18.39	7.1
WILL-5	5/16/2013	11.7	8.5	21.83	6.6
WILL-5	6/19/2013	9.6	8.8	28.45	6.8
WILL-5	7/25/2013	9.2	8.3	28.35	6
WILL-5	8/21/2013	8.1	7.8	27.47	7.3
WILL-5	9/17/2013	11.1	8.8	29	6.5
WILL-5	10/23/2013	7.1	7.7	21.75	6
WILL-5	4/21/2015	11.4	8.5	21.07	6.7
WILL-5	6/8/2015	12.0	8.8	27.58	6.9
WILL-5	6/29/2015	9.0	8.8	29.92	7.5
WILL-5	7/29/2015	6.3	8.1	32.67	6.2
WILL-5	8/19/2015	7.5	8.0	29.57	6.7
WILL-5	9/23/2015	6.6	7.9	26.56	5.9
WILL-5	10/21/2015	8.0	7.6	20.98	6.7

Table 11: Water Quality Data (Chl a, TP, TN) 2013, 2015

Station ID	Visit Date	Chl A (ug/L)	Chl A dc	Total P (mg/L)	Total P dc	TN (mg/L)
WILL-5	4/17/2013	14.95		0.037		0.655
WILL-5	5/16/2013	35.24		0.053		0.98
WILL-5	6/19/2013	11.21		0.04		0.644
WILL-5	7/25/2013	8.54		0.037		0.661
WILL-5	8/21/2013	4.81		0.05		0.732
WILL-5	9/17/2013	26.7		0.061		0.568
WILL-5	10/23/2013	14.42		0.055		0.604
WILL-5	4/21/2015	3.4		0.05		0.922
WILL-5	6/8/2015	3.4		0.022		0.749
WILL-5	6/29/2015	1.4		0.034		0.788
WILL-5	7/29/2015	18.2		0.038		0.953
WILL-5	8/19/2015	18.2		0.039		0.417
WILL-5	9/23/2015	16		0.038		0.405
WILL-5	10/21/2015	19.2		0.054		0.963
Note: Samples less than MDL recorded as half MDL						

Table 12: Water Quality Data (NH_3, $CBOD_5$, TKN) 2013, 2015

Station ID	Visit Date	NH_3 (mg/L)	NH_3 dc	$CBOD_5$ (mg/L)	$CBOD_5$ dc	TKN (mg/L)	TKN dc
WILL-5	4/17/2013	0.004	< MDL .008	1	< MDL 2	0.294	
WILL-5	5/16/2013	0.019	JI	2.3		0.873	
WILL-5	6/19/2013	0.009	< MDL .018	1	< MDL 2	0.635	
WILL-5	7/25/2013	0.009	< MDL .018	1	< MDL 2	0.659	
WILL-5	8/21/2013	0.009	< MDL .018	1	< MDL 2	0.65	
WILL-5	9/17/2013	0.009	< MDL .018	1	< MDL 2	0.567	
WILL-5	10/23/2013	0.002	< MDL .004	1	< MDL 2	0.362	
WILL-5	4/21/2015	0.022		3.2	JQ	0.535	
WILL-5	6/8/2015	0.005	< MDL .01	1	< MDL 2	0.745	
WILL-5	6/29/2015	0.005	< MDL .01	1	< MDL 2	0.779	
WILL-5	7/29/2015	0.022		1	< MDL 2	0.931	
WILL-5	8/19/2015	0.005	< MDL .01	1	< MDL 2	0.39	
WILL-5	9/23/2015	0.224		1	< MDL 2	0.381	
WILL-5	10/21/2015	0.122		1	< MDL 2	0.756	

Note: Samples less than MDL recorded as half MDL

Table 13: WILL-5 72-hour Diurnal Data 2015

Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)	Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)
9/23/2015 7:30	0	26.47	8.0	177	6.7	9/25/2015 22:00	62.5	26.33	8.1	177	7.5
9/23/2015 7:45	0.25	26.48	7.9	177	6.4	9/25/2015 22:15	62.75	26.3	8.0	177	7.5
9/23/2015 8:00	0.5	26.46	7.8	177	6.3	9/25/2015 22:30	63	26.3	8.0	177	7.4
9/23/2015 8:15	0.75	26.46	7.9	177	6.5	9/25/2015 22:45	63.25	26.3	8.0	177	7.4
9/23/2015 8:30	1	26.46	7.9	177	6.6	9/25/2015 23:00	63.5	26.29	8.1	176	7.5
9/23/2015 8:45	1.25	26.46	7.9	176	6.5	9/25/2015 23:15	63.75	26.29	8.0	177	7.4
9/23/2015 9:00	1.5	26.47	7.9	176	6.5	9/25/2015 23:30	64	26.28	8.0	177	7.4
9/23/2015 9:15	1.75	26.47	7.8	176	6.4	9/25/2015 23:45	64.25	26.27	8.0	177	7.3
9/23/2015 9:30	2	26.46	7.8	177	6.4	9/26/2015 0:00	64.5	26.25	8.0	177	7.3
9/23/2015 9:45	2.25	26.45	7.8	176	6.5	9/26/2015 0:15	64.75	26.24	8.0	177	7.3
9/23/2015 10:00	2.5	26.47	7.9	176	6.5	9/26/2015 0:30	65	26.26	8.0	176	7.2
9/23/2015 10:15	2.75	26.47	7.8	177	6.5	9/26/2015 0:45	65.25	26.25	8.0	177	7.2
9/23/2015 10:30	3	26.47	7.8	176	6.5	9/26/2015 1:00	65.5	26.23	8.0	177	7.2
9/23/2015 10:45	3.25	26.48	7.9	176	6.6	9/26/2015 1:15	65.75	26.23	8.0	177	7.3

Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)	Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)
9/23/2015 11:00	3.5	26.52	7.9	176	7.0	9/26/2015 1:30	66	26.22	8.0	177	7.3
9/23/2015 11:15	3.75	26.48	7.9	176	6.7	9/26/2015 1:45	66.25	26.21	8.0	177	7.3
9/23/2015 11:30	4	26.5	7.9	176	6.8	9/26/2015 2:00	66.5	26.21	8.0	177	7.2
9/23/2015 11:45	4.25	26.56	8.0	176	7.2	9/26/2015 2:15	66.75	26.2	8.0	177	7.2
9/23/2015 12:00	4.5	26.52	8.0	176	7.2	9/26/2015 2:30	67	26.2	7.9	177	7.1
9/23/2015 12:15	4.75	26.55	8.0	176	7.3	9/26/2015 2:45	67.25	26.16	7.9	177	6.9
9/23/2015 12:30	5	26.54	8.0	175	7.2	9/26/2015 3:00	67.5	26.18	7.9	177	7.1
9/23/2015 12:45	5.25	26.58	8.1	175	7.5	9/26/2015 3:15	67.75	26.17	8.0	177	7.4
9/23/2015 13:00	5.5	26.55	8.0	176	7.4	9/26/2015 3:30	68	26.16	8.0	177	7.1
9/23/2015 13:15	5.75	26.6	8.2	176	7.7	9/26/2015 3:45	68.25	26.16	8.0	177	7.2
9/23/2015 13:30	6	26.62	8.1	176	7.3	9/26/2015 4:00	68.5	26.15	8.0	177	7.3
9/23/2015 13:45	6.25	26.6	8.0	176	7.2	9/26/2015 4:15	68.75	26.14	8.0	177	7.2
9/23/2015 14:00	6.5	26.77	8.3	175	8.4	9/26/2015 4:30	69	26.13	7.9	177	7.1
9/23/2015 14:15	6.75	26.71	8.3	175	8.2	9/26/2015 4:45	69.25	26.12	8.0	177	7.1
9/23/2015 14:30	7	26.82	8.3	175	8.3	9/26/2015 5:00	69.5	26.12	8.0	177	7.2
9/23/2015 14:45	7.25	26.58	8.0	176	7.4	9/26/2015 5:15	69.75	26.11	7.9	177	7.1
9/23/2015 15:00	7.5	26.57	8.0	177	7.0	9/26/2015 5:30	70	26.08	7.9	177	7.0
9/23/2015 15:15	7.75	26.62	8.0	176	7.3	9/26/2015 5:45	70.25	26.09	7.9	177	7.0
9/23/2015 15:30	8	26.6	8.0	176	7.2	9/26/2015 6:00	70.5	26.08	7.9	177	7.1
9/23/2015 15:45	8.25	26.58	8.0	176	7.2	9/26/2015 6:15	70.75	26.08	7.9	177	7.0
9/23/2015 16:00	8.5	26.73	8.3	175	8.3	9/26/2015 6:30	71	26.06	7.9	177	6.9
9/23/2015 16:15	8.75	26.7	8.3	176	8.2	9/26/2015 6:45	71.25	26.06	7.9	177	7.1
9/23/2015 16:30	9	26.61	8.1	176	7.5	9/26/2015 7:00	71.5	26.06	7.9	177	6.9
9/23/2015 16:45	9.25	26.73	8.4	175	8.4	9/26/2015 7:15	71.75	26.04	7.9	177	7.1
9/23/2015 17:00	9.5	26.62	8.1	176	7.6	9/26/2015 7:30	72	26.05	7.9	177	7.0
9/23/2015 17:15	9.75	26.69	8.2	176	8.0	9/26/2015 7:45	72.25	26.04	7.9	177	7.0
9/23/2015 17:30	10	26.71	8.2	175	7.9	9/26/2015 8:00	72.5	26.03	7.9	177	7.1
9/23/2015 17:45	10.25	26.77	8.4	175	8.7	9/26/2015 8:15	72.75	26.03	7.9	177	6.9
9/23/2015 18:00	10.5	26.69	8.2	176	7.7	9/26/2015 8:30	73	26.03	7.9	177	7.0
9/23/2015 18:15	10.75	26.62	8.1	176	7.4	9/26/2015 8:45	73.25	26.02	7.9	177	6.9
9/23/2015 18:30	11	26.78	8.3	175	8.3	9/26/2015 9:00	73.5	26.01	7.9	177	7.0
9/23/2015 18:45	11.25	26.85	8.4	175	8.6	9/26/2015 9:15	73.75	26.01	7.9	177	7.0

Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)	Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)
9/23/2015 19:00	11.5	26.78	8.3	175	8.3	9/26/2015 9:30	74	26	7.9	177	7.0
9/23/2015 19:15	11.75	26.61	8.0	176	7.3	9/26/2015 9:45	74.25	26	7.9	177	6.9
9/23/2015 19:30	12	26.62	8.0	176	7.0	9/26/2015 10:00	74.5	26	7.9	177	7.0
9/23/2015 19:45	12.25	26.55	7.9	176	7.0	9/26/2015 10:15	74.75	25.99	7.9	177	7.0
9/23/2015 20:00	12.5	26.63	8.1	176	7.3	9/26/2015 10:30	75	26	7.9	177	7.0
9/23/2015 20:15	12.75	26.65	8.0	176	7.3	9/26/2015 10:45	75.25	25.99	7.9	177	6.9
9/23/2015 20:30	13	26.59	8.0	176	7.3	9/26/2015 11:00	75.5	25.99	7.9	177	7.1
9/23/2015 20:45	13.25	26.58	8.0	176	7.2	9/26/2015 11:15	75.75	26	7.9	177	7.1
9/23/2015 21:00	13.5	26.55	7.9	176	6.9	9/26/2015 11:30	76	26	7.9	177	7.1
9/23/2015 21:15	13.75	26.54	7.9	177	6.8	9/26/2015 11:45	76.25	26.01	7.9	177	7.2
9/23/2015 21:30	14	26.51	7.9	177	6.7	9/26/2015 12:00	76.5	26	7.9	177	7.1
9/23/2015 21:45	14.25	26.58	7.9	177	6.8	9/26/2015 12:15	76.75	26.03	8.0	177	7.3
9/23/2015 22:00	14.5	26.57	7.9	176	6.8	9/26/2015 12:30	77	26.02	7.9	177	7.1
9/23/2015 22:15	14.75	26.57	7.9	177	6.9	9/26/2015 12:45	77.25	26.04	8.0	176	7.3
9/23/2015 22:30	15	26.54	7.9	176	6.8	9/26/2015 13:00	77.5	26.02	7.9	177	7.1
9/23/2015 22:45	15.25	26.55	7.9	176	6.7	9/26/2015 13:15	77.75	26.01	7.9	177	7.1
9/23/2015 23:00	15.5	26.53	7.9	177	6.7	9/26/2015 13:30	78	26.04	7.9	176	7.1
9/23/2015 23:15	15.75	26.5	7.9	177	6.7	9/26/2015 13:45	78.25	26.08	8.0	177	7.5
9/23/2015 23:30	16	26.51	7.9	177	6.7	9/26/2015 14:00	78.5	26.09	8.0	177	7.3
9/23/2015 23:45	16.25	26.56	7.8	177	6.6	9/26/2015 14:15	78.75	26.09	8.0	177	7.3
9/24/2015 0:00	16.5	26.59	7.8	177	6.6	9/26/2015 14:30	79	26.1	8.0	177	7.3
9/24/2015 0:15	16.75	26.57	7.9	177	6.7	9/26/2015 14:45	79.25	26.1	8.0	177	7.3
9/24/2015 0:30	17	26.54	7.9	177	6.6	9/26/2015 15:00	79.5	26.11	8.0	177	7.6
9/24/2015 0:45	17.25	26.63	8.0	176	7.0	9/26/2015 15:15	79.75	26.11	7.9	177	7.3
9/24/2015 1:00	17.5	26.57	7.9	177	7.0	9/26/2015 15:30	80	26.13	7.9	177	7.3
9/24/2015 1:15	17.75	26.81	8.1	176	7.7	9/26/2015 15:45	80.25	26.11	7.9	177	7.2
9/24/2015 1:30	18	26.57	7.9	177	6.9	9/26/2015 16:00	80.5	26.1	7.9	177	7.2
9/24/2015 1:45	18.25	26.59	7.9	177	7.0	9/26/2015 16:15	80.75	26.11	7.9	177	7.0
9/24/2015 2:00	18.5	26.58	7.9	177	6.8	9/26/2015 16:30	81	26.1	7.8	177	6.9
9/24/2015 2:15	18.75	26.58	8.0	177	7.1	9/26/2015 16:45	81.25	26.1	7.8	177	6.8
9/24/2015 2:30	19	26.6	8.0	177	7.1	9/26/2015 17:00	81.5	26.16	8.1	177	7.5
9/24/2015 2:45	19.25	26.75	8.2	176	8.1	9/26/2015 17:15	81.75	26.17	8.1	177	7.7

Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)	Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)
9/24/2015 3:00	19.5	26.7	8.0	176	7.2	9/26/2015 17:30	82	26.17	8.2	177	8.2
9/24/2015 3:15	19.75	26.6	8.0	177	7.1	9/26/2015 17:45	82.25	26.18	8.2	177	8.3
9/24/2015 3:30	20	26.67	8.2	175	7.7	9/26/2015 18:00	82.5	26.16	8.0	177	7.3
9/24/2015 3:45	20.25	26.61	8.0	176	7.0	9/26/2015 18:15	82.75	26.17	8.1	177	7.9
9/24/2015 4:00	20.5	26.62	8.0	176	7.4	9/26/2015 18:30	83	26.18	8.2	177	8.2
9/24/2015 4:15	20.75	26.62	8.2	176	7.9	9/26/2015 18:45	83.25	26.17	8.2	177	8.2
9/24/2015 4:30	21	26.6	8.3	176	8.2	9/26/2015 19:00	83.5	26.16	8.1	177	7.9
9/24/2015 4:45	21.25	26.59	8.2	176	8.1	9/26/2015 19:15	83.75	26.15	8.1	177	8.0
9/24/2015 5:00	21.5	26.57	8.2	176	8.0	9/26/2015 19:30	84	26.14	8.0	177	7.5
9/24/2015 5:15	21.75	26.54	8.2	176	7.7	9/26/2015 19:45	84.25	26.13	8.0	177	7.3
9/24/2015 5:30	22	26.52	8.2	176	7.6	9/26/2015 20:00	84.5	26.12	8.0	177	7.6
9/24/2015 5:45	22.25	26.5	8.2	176	7.8	9/26/2015 20:15	84.75	26.12	8.0	177	7.4
9/24/2015 6:00	22.5	26.47	8.2	176	7.8	9/26/2015 20:30	85	26.11	8.0	177	7.7
9/24/2015 6:15	22.75	26.45	8.2	176	7.7	9/26/2015 20:45	85.25	26.09	8.1	177	7.9
9/24/2015 6:30	23	26.44	8.1	176	7.6	9/26/2015 21:00	85.5	26.09	8.0	177	7.6
9/24/2015 6:45	23.25	26.42	8.0	177	7.2	9/26/2015 21:15	85.75	26.08	8.1	177	7.7
9/24/2015 7:00	23.5	26.4	8.0	176	7.3	9/26/2015 21:30	86	26.06	8.0	177	7.5
9/24/2015 7:15	23.75	26.4	7.9	176	6.9	9/26/2015 21:45	86.25	26.05	8.0	177	7.3
9/24/2015 7:30	24	26.39	7.9	176	6.9	9/26/2015 22:00	86.5	26.05	8.0	177	7.5
9/24/2015 7:45	24.25	26.39	7.8	176	6.6	9/26/2015 22:15	86.75	26.02	8.0	177	7.4
9/24/2015 8:00	24.5	26.37	7.8	176	6.5	9/26/2015 22:30	87	26.02	8.0	177	7.3
9/24/2015 8:15	24.75	26.37	7.8	177	6.3	9/26/2015 22:45	87.25	26.02	8.0	177	7.3
9/24/2015 8:30	25	26.37	7.7	177	6.3	9/26/2015 23:00	87.5	26.01	7.9	177	7.3
9/24/2015 8:45	25.25	26.38	7.8	177	6.3	9/26/2015 23:15	87.75	26	7.9	177	7.2
9/24/2015 9:00	25.5	26.38	7.8	177	6.3	9/26/2015 23:30	88	25.98	7.9	177	7.2
9/24/2015 9:15	25.75	26.38	7.8	176	6.4	9/26/2015 23:45	88.25	25.99	7.9	177	7.1
9/24/2015 9:30	26	26.38	7.8	176	6.4	9/27/2015 0:00	88.5	25.97	7.9	177	7.1
9/24/2015 9:45	26.25	26.38	7.7	177	6.3	9/27/2015 0:15	88.75	25.97	7.9	177	7.0
9/24/2015 10:00	26.5	26.39	7.7	177	6.4	9/27/2015 0:30	89	25.96	7.9	177	7.0
9/24/2015 10:15	26.75	26.41	7.7	177	6.3	9/27/2015 0:45	89.25	25.95	7.9	177	7.1
9/24/2015 10:30	27	26.4	7.8	176	6.4	9/27/2015 1:00	89.5	25.95	7.9	177	7.0
9/24/2015 10:45	27.25	26.44	7.8	177	6.6	9/27/2015 1:15	89.75	25.95	7.9	177	7.0

Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)	Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)
9/24/2015 11:00	27.5	26.46	7.8	177	6.7	9/27/2015 1:30	90	25.93	7.9	177	7.0
9/24/2015 11:15	27.75	26.52	7.9	177	7.1	9/27/2015 1:45	90.25	25.91	7.9	177	6.9
9/24/2015 11:30	28	26.49	7.9	176	7.0	9/27/2015 2:00	90.5	25.93	7.9	177	7.0
9/24/2015 11:45	28.25	26.44	7.8	177	6.7	9/27/2015 2:15	90.75	25.92	7.9	177	6.9
9/24/2015 12:00	28.5	26.46	7.9	176	6.8	9/27/2015 2:30	91	25.9	7.8	177	6.9
9/24/2015 12:15	28.75	26.41	7.8	177	6.4	9/27/2015 2:45	91.25	25.9	7.8	177	6.7
9/24/2015 12:30	29	26.45	7.8	176	6.7	9/27/2015 3:00	91.5	25.89	7.8	177	6.8
9/24/2015 12:45	29.25	26.42	7.8	176	6.5	9/27/2015 3:15	91.75	25.88	7.8	177	6.7
9/24/2015 13:00	29.5	26.44	7.8	177	6.6	9/27/2015 3:30	92	25.88	7.8	177	6.7
9/24/2015 13:15	29.75	26.48	7.9	177	6.8	9/27/2015 3:45	92.25	25.88	7.8	177	6.8
9/24/2015 13:30	30	26.48	7.9	177	6.9	9/27/2015 4:00	92.5	25.87	7.8	177	6.8
9/24/2015 13:45	30.25	26.49	7.9	176	7.0	9/27/2015 4:15	92.75	25.86	7.8	177	6.7
9/24/2015 14:00	30.5	26.47	7.9	176	6.9	9/27/2015 4:30	93	25.85	7.8	177	6.7
9/24/2015 14:15	30.75	26.5	7.9	177	7.0	9/27/2015 4:45	93.25	25.86	7.8	177	6.7
9/24/2015 14:30	31	26.53	8.0	176	7.3	9/27/2015 5:00	93.5	25.85	7.8	177	6.7
9/24/2015 14:45	31.25	26.52	8.0	176	7.6	9/27/2015 5:15	93.75	25.84	7.8	177	6.6
9/24/2015 15:00	31.5	26.67	8.3	176	8.3	9/27/2015 5:30	94	25.83	7.8	177	6.6
9/24/2015 15:15	31.75	26.57	8.1	176	7.8	9/27/2015 5:45	94.25	25.82	7.8	177	6.7
9/24/2015 15:30	32	26.57	8.0	177	7.2	9/27/2015 6:00	94.5	25.82	7.8	177	6.6
9/24/2015 15:45	32.25	26.55	8.0	177	7.4	9/27/2015 6:15	94.75	25.82	7.8	177	6.6
9/24/2015 16:00	32.5	26.48	7.9	177	6.7	9/27/2015 6:30	95	25.8	7.8	177	6.6
9/24/2015 16:15	32.75	26.53	7.9	177	7.1	9/27/2015 6:45	95.25	25.8	7.8	177	6.7
9/24/2015 16:30	33	26.6	8.1	177	7.7	9/27/2015 7:00	95.5	25.8	7.8	177	6.7
9/24/2015 16:45	33.25	26.51	7.9	177	7.0	9/27/2015 7:15	95.75	25.78	7.8	178	6.7
9/24/2015 17:00	33.5	26.67	8.2	176	8.2	9/27/2015 7:30	96	25.79	7.8	177	6.6
9/24/2015 17:15	33.75	26.54	7.9	177	7.1	9/27/2015 7:45	96.25	25.78	7.8	177	6.6
9/24/2015 17:30	34	26.69	8.2	176	8.1	9/27/2015 8:00	96.5	25.78	7.8	177	6.6
9/24/2015 17:45	34.25	26.62	8.1	176	7.6	9/27/2015 8:15	96.75	25.78	7.8	177	6.6
9/24/2015 18:00	34.5	26.62	8.2	176	7.9	9/27/2015 8:30	97	25.76	7.8	177	6.7
9/24/2015 18:15	34.75	26.64	8.2	176	7.9	9/27/2015 8:45	97.25	25.77	7.8	177	6.6
9/24/2015 18:30	35	26.64	8.2	176	7.9	9/27/2015 9:00	97.5	25.77	7.8	178	6.6
9/24/2015 18:45	35.25	26.58	8.1	177	7.7	9/27/2015 9:15	97.75	25.76	7.8	177	6.7

Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)	Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)
9/24/2015 19:00	35.5	26.59	8.1	177	7.8	9/27/2015 9:30	98	25.76	7.8	177	6.6
9/24/2015 19:15	35.75	26.54	7.9	176	7.2	9/27/2015 9:45	98.25	25.75	7.8	177	6.6
9/24/2015 19:30	36	26.5	7.9	176	7.1	9/27/2015 10:00	98.5	25.75	7.8	177	6.7
9/24/2015 19:45	36.25	26.57	8.0	176	7.2	9/27/2015 10:15	98.75	25.76	7.8	177	6.8
9/24/2015 20:00	36.5	26.56	8.0	177	7.3	9/27/2015 10:30	99	25.75	7.8	177	6.7
9/24/2015 20:15	36.75	26.52	7.9	176	7.1	9/27/2015 10:45	99.25	25.75	7.8	177	6.9
9/24/2015 20:30	37	26.47	7.9	176	6.9	9/27/2015 11:00	99.5	25.74	7.8	177	6.6
9/24/2015 20:45	37.25	26.52	7.9	177	7.2	9/27/2015 11:15	99.75	25.76	7.8	177	6.9
9/24/2015 21:00	37.5	26.55	8.0	177	7.3	9/27/2015 11:30	100	25.78	7.8	177	6.9
9/24/2015 21:15	37.75	26.54	7.9	177	7.1	9/27/2015 11:45	100.25	25.8	7.8	177	6.9
9/24/2015 21:30	38	26.44	7.8	177	6.5	9/27/2015 12:00	100.5	25.79	7.8	177	6.8
9/24/2015 21:45	38.25	26.46	7.8	177	6.8	9/27/2015 12:15	100.75	25.81	7.7	178	6.5
9/24/2015 22:00	38.5	26.47	7.8	177	6.6	9/27/2015 12:30	101	25.79	7.7	177	6.6
9/24/2015 22:15	38.75	26.45	7.7	177	6.4	9/27/2015 12:45	101.25	25.8	7.7	177	6.5
9/24/2015 22:30	39	26.46	7.8	177	6.4	9/27/2015 13:00	101.5	25.82	7.7	177	6.6
9/24/2015 22:45	39.25	26.44	7.7	177	6.3	9/27/2015 13:15	101.75	25.86	7.8	177	6.8
9/24/2015 23:00	39.5	26.45	7.7	177	6.4	9/27/2015 13:30	102	25.84	7.8	177	6.7
9/24/2015 23:15	39.75	26.43	7.7	177	6.3	9/27/2015 13:45	102.25	25.92	7.9	177	7.4
9/24/2015 23:30	40	26.46	7.7	177	6.3	9/27/2015 14:00	102.5	25.93	7.9	177	7.4
9/24/2015 23:45	40.25	26.45	7.7	177	6.4	9/27/2015 14:15	102.75	26	8.0	177	7.7
9/25/2015 0:00	40.5	26.43	7.7	177	6.2	9/27/2015 14:30	103	26	8.1	177	7.8
9/25/2015 0:15	40.75	26.48	7.7	177	6.4	9/27/2015 14:45	103.25	25.94	8.0	177	7.5
9/25/2015 0:30	41	26.44	7.7	177	6.3	9/27/2015 15:00	103.5	26.02	8.1	177	8.0
9/25/2015 0:45	41.25	26.49	7.8	177	6.5	9/27/2015 15:15	103.75	26.05	8.3	177	8.6
9/25/2015 1:00	41.5	26.44	7.7	177	6.3	9/27/2015 15:30	104	26.01	8.2	176	8.1
9/25/2015 1:15	41.75	26.5	7.8	177	6.6	9/27/2015 15:45	104.25	26.03	8.2	177	8.2
9/25/2015 1:30	42	26.47	7.8	177	6.5	9/27/2015 16:00	104.5	25.97	8.1	177	8.0
9/25/2015 1:45	42.25	26.56	7.9	177	7.0	9/27/2015 16:15	104.75	25.96	8.1	177	7.9
9/25/2015 2:00	42.5	26.48	7.8	177	6.5	9/27/2015 16:30	105	25.94	8.0	177	7.6
9/25/2015 2:15	42.75	26.5	7.8	177	6.6	9/27/2015 16:45	105.25	25.94	8.0	177	7.7
9/25/2015 2:30	43	26.55	8.1	176	8.0	9/27/2015 17:00	105.5	25.95	8.1	177	8.0
9/25/2015 2:45	43.25	26.49	7.9	177	6.8	9/27/2015 17:15	105.75	25.91	8.0	177	7.4

Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)	Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)
9/25/2015 3:00	43.5	26.5	8.1	176	7.5	9/27/2015 17:30	106	25.88	7.9	177	7.0
9/25/2015 3:15	43.75	26.49	8.0	176	7.5	9/27/2015 17:45	106.25	25.94	8.1	177	7.8
9/25/2015 3:30	44	26.48	7.9	176	7.5	9/27/2015 18:00	106.5	25.96	8.3	177	8.6
9/25/2015 3:45	44.25	26.47	8.0	176	7.4	9/27/2015 18:15	106.75	25.95	8.3	176	8.4
9/25/2015 4:00	44.5	26.45	8.0	176	7.5	9/27/2015 18:30	107	25.93	8.3	176	8.3
9/25/2015 4:15	44.75	26.44	7.9	176	7.0	9/27/2015 18:45	107.25	25.91	8.2	177	8.2
9/25/2015 4:30	45	26.43	7.9	177	6.9	9/27/2015 19:00	107.5	25.9	8.2	177	8.1
9/25/2015 4:45	45.25	26.42	7.8	177	6.9	9/27/2015 19:15	107.75	25.9	8.2	177	8.2
9/25/2015 5:00	45.5	26.41	7.8	177	6.4	9/27/2015 19:30	108	25.9	8.2	177	8.2
9/25/2015 5:15	45.75	26.4	7.8	177	6.7	9/27/2015 19:45	108.25	25.88	8.2	176	8.1
9/25/2015 5:30	46	26.39	7.8	177	6.7	9/27/2015 20:00	108.5	25.87	8.2	177	7.8
9/25/2015 5:45	46.25	26.38	7.8	177	6.7	9/27/2015 20:15	108.75	25.84	8.0	177	7.4
9/25/2015 6:00	46.5	26.37	7.7	177	5.9	9/27/2015 20:30	109	25.86	8.0	177	7.4
9/25/2015 6:15	46.75	26.36	7.7	177	6.4	9/27/2015 20:45	109.25	25.85	8.0	177	7.4
9/25/2015 6:30	47	26.35	7.7	177	5.9	9/27/2015 21:00	109.5	25.84	8.0	177	7.3
9/25/2015 6:45	47.25	26.34	7.7	177	6.0	9/27/2015 21:15	109.75	25.83	8.0	177	7.3
9/25/2015 7:00	47.5	26.34	7.6	177	5.7	9/27/2015 21:30	110	25.8	8.0	177	7.3
9/25/2015 7:15	47.75	26.33	7.6	177	5.9	9/27/2015 21:45	110.25	25.8	7.9	177	7.3
9/25/2015 7:30	48	26.32	7.7	177	6.1	9/27/2015 22:00	110.5	25.78	7.9	177	7.1
9/25/2015 7:45	48.25	26.32	7.7	177	6.0	9/27/2015 22:15	110.75	25.78	7.9	177	7.1
9/25/2015 8:00	48.5	26.31	7.8	177	6.6	9/27/2015 22:30	111	25.78	7.9	177	7.0
9/25/2015 8:15	48.75	26.31	7.7	177	6.4	9/27/2015 22:45	111.25	25.77	7.9	177	6.9
9/25/2015 8:30	49	26.3	7.7	177	6.3	9/27/2015 23:00	111.5	25.77	7.8	177	6.9
9/25/2015 8:45	49.25	26.29	7.8	177	6.5	9/27/2015 23:15	111.75	25.76	7.8	178	6.9
9/25/2015 9:00	49.5	26.29	7.8	177	6.5	9/27/2015 23:30	112	25.75	7.8	178	6.9
9/25/2015 9:15	49.75	26.28	7.7	177	6.4	9/27/2015 23:45	112.25	25.74	7.8	178	6.8
9/25/2015 9:30	50	26.29	7.8	177	6.6	9/28/2015 0:00	112.5	25.74	7.8	177	6.7
9/25/2015 9:45	50.25	26.3	7.8	177	6.6	9/28/2015 0:15	112.75	25.74	7.8	177	6.8
9/25/2015 10:00	50.5	26.28	7.8	177	6.6	9/28/2015 0:30	113	25.72	7.8	177	6.7
9/25/2015 10:15	50.75	26.29	7.8	177	6.7	9/28/2015 0:45	113.25	25.73	7.8	177	6.7
9/25/2015 10:30	51	26.29	7.8	177	6.7	9/28/2015 1:00	113.5	25.71	7.8	177	6.7
9/25/2015 10:45	51.25	26.32	7.8	177	6.8	9/28/2015 1:15	113.75	25.71	7.8	177	6.6

Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)	Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)
9/25/2015 11:00	51.5	26.36	7.9	177	7.1	9/28/2015 1:30	114	25.7	7.8	177	6.7
9/25/2015 11:15	51.75	26.35	7.9	177	7.0	9/28/2015 1:45	114.25	25.69	7.8	177	6.7
9/25/2015 11:30	52	26.39	7.9	177	7.2	9/28/2015 2:00	114.5	25.68	7.8	177	6.7
9/25/2015 11:45	52.25	26.37	7.9	177	7.1	9/28/2015 2:15	114.75	25.69	7.8	177	6.7
9/25/2015 12:00	52.5	26.4	8.0	177	7.2	9/28/2015 2:30	115	25.68	7.8	177	6.7
9/25/2015 12:15	52.75	26.42	8.0	176	7.5	9/28/2015 2:45	115.25	25.67	7.8	177	6.6
9/25/2015 12:30	53	26.41	8.0	177	7.5	9/28/2015 3:00	115.5	25.67	7.8	177	6.7
9/25/2015 12:45	53.25	26.43	8.1	177	7.7	9/28/2015 3:15	115.75	25.65	7.8	177	6.6
9/25/2015 13:00	53.5	26.41	8.1	177	7.6	9/28/2015 3:30	116	25.66	7.8	177	6.5
9/25/2015 13:15	53.75	26.4	8.1	176	7.6	9/28/2015 3:45	116.25	25.65	7.8	177	6.6
9/25/2015 13:30	54	26.43	8.1	176	7.7	9/28/2015 4:00	116.5	25.64	7.8	177	6.6
9/25/2015 13:45	54.25	26.49	8.2	176	8.1	9/28/2015 4:15	116.75	25.63	7.8	177	6.5
9/25/2015 14:00	54.5	26.47	8.1	176	7.9	9/28/2015 4:30	117	25.62	7.8	177	6.6
9/25/2015 14:15	54.75	26.5	8.2	177	8.2	9/28/2015 4:45	117.25	25.61	7.8	177	6.5
9/25/2015 14:30	55	26.65	8.3	176	8.6	9/28/2015 5:00	117.5	25.61	7.8	177	6.5
9/25/2015 14:45	55.25	26.46	8.1	176	7.8	9/28/2015 5:15	117.75	25.61	7.8	177	6.5
9/25/2015 15:00	55.5	26.46	8.1	176	7.8	9/28/2015 5:30	118	25.6	7.8	177	6.5
9/25/2015 15:15	55.75	26.49	8.2	177	8.1	9/28/2015 5:45	118.25	25.59	7.7	177	6.5
9/25/2015 15:30	56	26.52	8.3	176	8.3	9/28/2015 6:00	118.5	25.58	7.7	177	6.5
9/25/2015 15:45	56.25	26.41	8.0	177	7.3	9/28/2015 6:15	118.75	25.59	7.7	177	6.4
9/25/2015 16:00	56.5	26.5	8.2	177	7.9	9/28/2015 6:30	119	25.57	7.7	177	6.5
9/25/2015 16:15	56.75	26.42	8.0	176	7.2	9/28/2015 6:45	119.25	25.57	7.7	177	6.4
9/25/2015 16:30	57	26.45	8.0	176	7.3	9/28/2015 7:00	119.5	25.56	7.7	177	6.3
9/25/2015 16:45	57.25	26.53	8.4	176	8.6	9/28/2015 7:15	119.75	25.56	7.7	177	6.3
9/25/2015 17:00	57.5	26.54	8.4	176	8.7	9/28/2015 7:30	120	25.56	7.7	177	6.4
9/25/2015 17:15	57.75	26.56	8.5	175	9.4	9/28/2015 7:45	120.25	25.56	7.7	177	6.2
9/25/2015 17:30	58	26.54	8.6	175	9.6	9/28/2015 8:00	120.5	25.56	7.7	177	6.1
9/25/2015 17:45	58.25	26.54	8.6	175	9.6	9/28/2015 8:15	120.75	25.56	7.7	177	6.2
9/25/2015 18:00	58.5	26.52	8.5	176	9.3	9/28/2015 8:30	121	25.55	7.7	177	6.3
9/25/2015 18:15	58.75	26.5	8.6	176	9.5	9/28/2015 8:45	121.25	25.55	7.7	177	6.2
9/25/2015 18:30	59	26.52	8.6	175	9.4	9/28/2015 9:00	121.5	25.56	7.7	177	6.2
9/25/2015 18:45	59.25	26.48	8.5	176	9.3	9/28/2015 9:15	121.75	25.55	7.7	177	6.2

Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)		Date Time	Elapsed Time (hrs)	Temp C	pH_SU	SpCond (uS/cm)	DO (mg/L)
9/25/2015 19:00	59.5	26.48	8.5	175	9.3		9/28/2015 9:30	122	25.56	7.7	177	6.3
9/25/2015 19:15	59.75	26.47	8.5	176	9.0		9/28/2015 9:45	122.25	25.55	7.7	177	6.3
9/25/2015 19:30	60	26.46	8.4	176	8.9		9/28/2015 10:00	122.5	25.56	7.7	177	6.2
9/25/2015 19:45	60.25	26.42	8.4	176	8.9		9/28/2015 10:15	122.75	25.56	7.7	178	6.2
9/25/2015 20:00	60.5	26.41	8.4	176	8.7		9/28/2015 10:30	123	25.56	7.7	178	6.1
9/25/2015 20:15	60.75	26.41	8.3	176	8.5		9/28/2015 10:45	123.25	25.57	7.7	178	6.1
9/25/2015 20:30	61	26.38	8.3	177	8.2		9/28/2015 11:00	123.5	25.58	7.7	177	6.3
9/25/2015 20:45	61.25	26.38	8.1	177	7.7		9/28/2015 11:15	123.75	25.58	7.7	177	6.4
9/25/2015 21:00	61.5	26.36	8.2	176	8.0		9/28/2015 11:30	124	25.58	7.7	177	6.3
9/25/2015 21:15	61.75	26.37	8.1	177	7.8		9/28/2015 11:45	124.25	25.58	7.7	177	6.2
9/25/2015 21:30	62	26.35	8.1	177	7.7		9/28/2015 12:00	124.5	25.57	7.7	177	6.2
9/25/2015 21:45	62.25	26.33	8.1	176	7.7		9/28/2015 12:15	124.75	25.58	7.7	177	6.1

7.3 Ecoregional Reference Guidelines

Figure 6: Ecoregional Map of Alabama

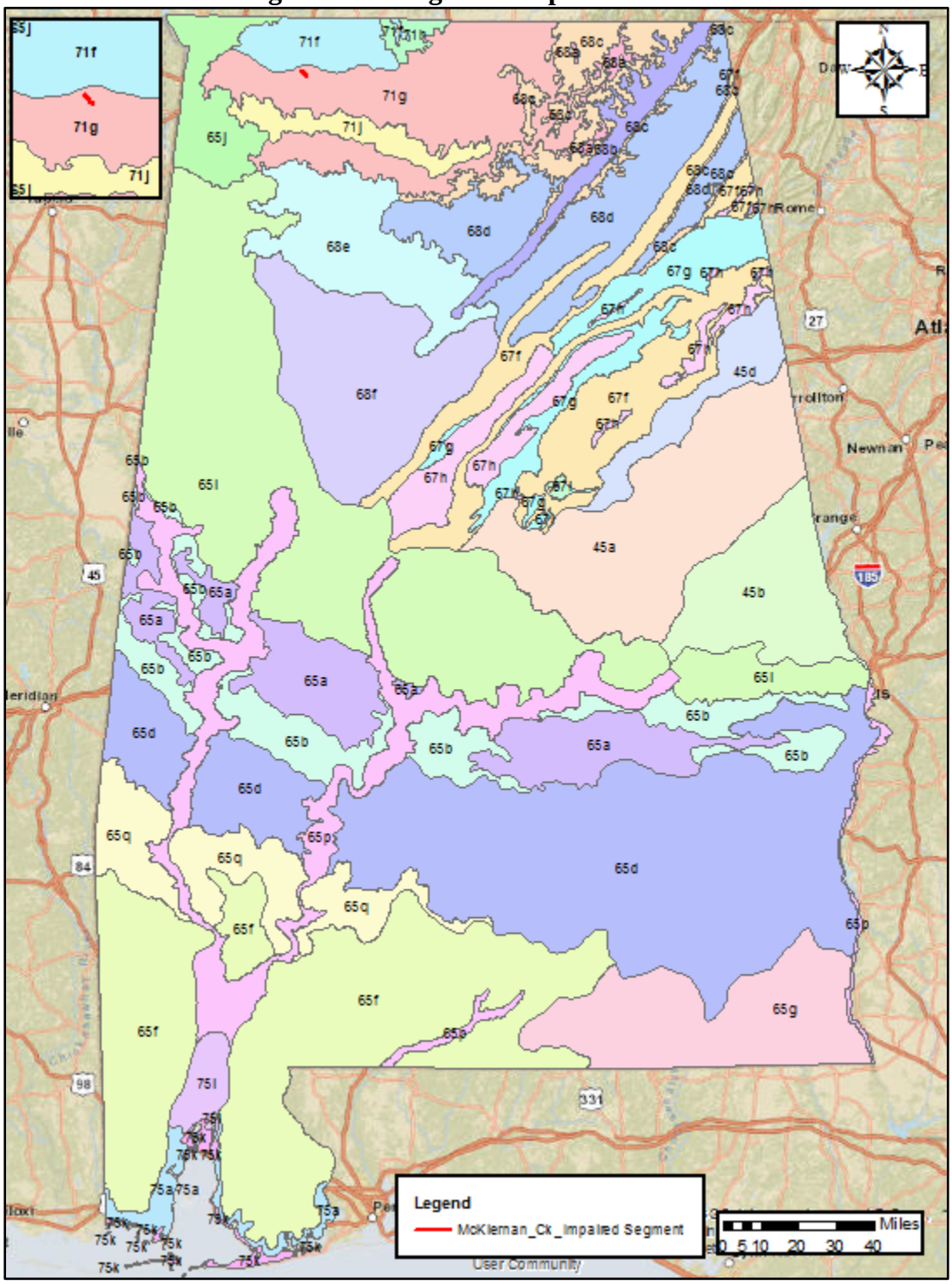


Figure 7: Ecoregional Reference Guidelines

			Level 4	Level 4	Level 3	Level 4	Level 4	Level 4	Level 4	Level 4	Level 4	Level 4	Level 4	Level 3	Level 4	Level 4	Level 3	Level 4	Level 3
Parameters	Basis of comparison	Result to compare	45a	45d	45	65a/b	65f	65g	65i	65j	65q	67f	67h	67	68d	68e	68	71f	71
Physical																			
Temperature (°C)	90th %ile	Median	24.656	25	25	27	24.6	27	25	24	27	24	26	25.7	25	23.48	24	22.12	22.586
Turbidity (NTU)	90th %ile	INDIVIDUAL	21.7	6.823	15	49.56	9.7	13.05	26.21	10.73	42.3	6.622	10.787	8.824	9.667	9.025	10.1	3.693	11.1
Total Dissolved Solids (mg/L)	90th %ile	Median	67.9	85.4	80	162.8	53.4	97.4	63.3	167.6	103.4	165	79.4	151.2	118	84.8	97.2	79.6	150.5
Total Suspended Solids (mg/L)	90th %ile	Median	16	12	15	45	13.2	16.3	27.5	26.9	104.6	11.3	12.7	12.4	27	10	14	9.6	8.9
Specific Conductance (µmhos)	Median	Median	40.1	37	39.05	129.7	20.4	53.4	25.8	70	72.5	207	34.35	86	49.5	37	39.15	96	109
Hardness (mg/L)	Median	Median	10.65	11.1	11	56	14	14.2	6.52	82.1	34.6	94.05	8.56	42.3	16.2	10	12.15	47.2	56
Alkalinity (mg/L)	90th %ile	Median	21.8	23.5	23.01	84.41	11.8	21.85	21.05	130.6	36.36	121.73	16.54	117.72	21	44.2	42.2	57.492	109.4
Stream Flow (cfs)																			
Chemical																			
Dissolved Oxygen (mg/L)	10th %ile	Median	7.665	7.6	7.6	5.1	6.94	4.484	6.692	7.64	6.8	7.44	7	7	5.609	7.51	6.79	8.113	7.61
pH (su)	10th %ile	Median	6.5	6.787	6.64	6.758	4.436	5.69	5.82	6.31	6.6	6.938	6.69	6.768	6.482	6.522	6.5	7.162	7.345
pH (su)	90th %ile	Median	7.68	7.679	7.7	8.052	6.55	6.815	7.18	8.1	7.74	8.294	8	8.278	7.352	7.852	7.84	8.35	8.34
Ammonia Nitrogen (mg/L)	90th %ile	Median	0.0078	0.0105	0.0105	0.048	0.046	0.02	0.091	0.093	0.074	0.0228	0.031	0.0346	0.119	0.095	0.1007	0.023	0.023
Nitrate+Nitrite Nitrogen (mg/L)	90th %ile	Median	0.1241	0.0718	0.0974	0.286	0.3258	0.243	0.276	0.344	0.0634	0.261	0.0888	0.2403	1.202	0.456	0.6191	0.6895	1.42
Total Kjeldahl Nitrogen (mg/L)	90th %ile	Median	0.4048	0.2598	0.2845	0.887	0.4176	0.583	0.678	0.486	0.6346	0.431	0.5107	0.5826	1.46	0.66	0.733	0.624	0.466
Total Nitrogen (mg/L)	90th %ile	Median	0.5311	0.3224	0.4002	1.163	0.6396	0.773	0.851	0.806	0.6921	0.6836	0.6937	0.7109	2.269	0.919	1.4169	1.295	1.57
Dissolved Reactive Phosphorus (mg/L)	90th %ile	Median	0.0214	0.027	0.0243	0.062	0.0264	0.024	0.023	0.017	0.0193	0.0174	0.0162	0.017	0.0109	0.019	0.0182	0.017	0.0155
Total Phosphorus (mg/L)	90th %ile	Median	0.0663	0.0537	0.0599	0.201	0.04	0.07	0.068	0.058	0.064	0.0514	0.0429	0.0566	0.0491	0.05	0.05	0.1059	0.0497
CBOD-5 (mg/L)	90th %ile	Median	2.57	2.37	2.4	3.2	1.96	2.65	2	2.53	2.3	1.78	2.58	2.3	1.86	1.9	1.9	1.1	1.1
Chlorides (mg/L)	90th %ile	Median	4.778	4.029	4.495	12.03	6.692	6.066	4.285	5.247	5.95	4.266	3.61	3.89	9.118	1.051	6.37	2.4112	2.622
Total Metals																			
Aluminum (mg/L)	90th %ile	Median	0.2437	0.1558	0.1954	1.181	0.4886	0.273	0.801	0.405	1.561	0.2104	0.356	0.4114	0.155	0.265	0.3055	0.1954	0.127
Iron (mg/L)	90th %ile	Median	1.094	0.5648	0.8722	2.362	1.352	3.976	3.548	0.839	2.13	0.893	0.733	0.9803	0.6855	1.047	1.046	0.4085	0.4294
Manganese (mg/L)	90th %ile	Median	0.0554	0.0647	0.057	0.215	0.0436	0.737	0.809	0.081	0.113	0.067	0.052	0.0628	0.184	0.056	0.1553	0.025	0.025
Dissolved Metals																			
Aluminum (mg/L)	90th %ile	Median	0.0549	0.0545	0.0545	0.137	0.2242	0.055	0.1	0.11	0.193	0.1	0.1	0.1	0.1	0.1	0.1	0.03	0.03
Antimony (µg/L)	90th %ile	Median	1	1	1	1	3.75	1	5	5	3.75	5	1	5		14	14	5	5
Arsenic (µg/L)	90th %ile	Median	5	5	5	5	5	5	5	5	5	9.2	5	5		5	5	12.1	12
Cadmium (mg/L)	90th %ile	Median	0.0435	0.0435	0.0435	0.044	0.0394	0.044	0.044	0.044	0.0435	0.0435	0.0435	0.0435		0.045	0.0442	0.0075	0.0075
Chromium (mg/L)	90th %ile	Median	0.0395	0.0395	0.0395	0.04	0.0321	0.04	0.04	0.04	0.0395	0.0395	0.0395	0.0395		0.042	0.0406	0.025	0.025
Copper (mg/L)	90th %ile	Median	0.043	0.043	0.043	0.043	0.0349	0.043	0.043	0.075	0.043	0.043	0.043	0.043	0.0238	0.043	0.043	0.1	0.1
Iron (mg/L)	90th %ile	Median	0.292	0.2248	0.256	0.503	0.6132	0.804	0.539	0.245	1.255	0.1218	0.1885	0.2428	0.1552	0.588	0.588	0.025	0.0579
Lead (µg/L)	90th %ile	Median	1	1	1	1	2.5	1	5	5	2.5	5	1	5	1	5	5	5	5
Manganese (mg/L)	90th %ile	Median	0.0267	0.0235	0.0253	0.122	0.0328	0.789	0.822	0.025	0.1084	0.025	0.0235	0.025		0.05	0.05	0.025	0.025
Mercury (µg/L)	90th %ile	Median	0.15	0.15	0.15	0.15	0.25	0.15	0.25	0.2	0.25	0.2	0.2	0.2	0.18	0.2	0.2	0.15	0.15
Nickel (mg/L)	90th %ile	Median	0.114	0.114	0.114	0.114	0.0936	0.114	0.05	0.114	0.114	0.0884	0.114	0.114		0.114	0.114	0.025	0.025
Selenium (µg/L)	90th %ile	Median	5	5	5	5	5	5	25	23	5	23	5	5		50	50	15	25
Silver (mg/L)	90th %ile	Median	0.058	0.058	0.058	0.058	0.0467	0.058	0.05	0.058	0.058	0.0548	0.058	0.058		0.058	0.058	0.025	0.025
Thallium (µg/L)	90th %ile	Median	0.5	0.5	0.5	0.5	4.5	0.5	5	5	4.5	5	0.5	5		18.5	18.5	5	5
Zinc (mg/L)	90th %ile	Median	0.0345	0.0345	0.0345	0.035	0.0294	0.035	0.035	0.035	0.0345	0.0345	0.0345	0.0345	0.0267	0.044	0.0345	0.03	0.0285
Biological																			
Chlorophyll a (µg/L)	90th %ile	Median	5.019	2.14	2.67	5.181	1.755	1.282	4.732	3.31	3.949	2.562	2.086	2.322	1.392	2.458	2.67	3.044	4.255
Fecal Coliform (col/100 mL)	90th %ile	Median	332	116	201.2	1564	400	234	620	582	1025	141.6	152.2	197	823	252	320	200	435

7.4 Pictures of Stations

Figure 8: Upstream picture at station WILL-5 (9/25/13)

Figure 9: Downstream picture at station WILL-5 (9/25/13)